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Automation: an informational report

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AUTOMATION

AN INFORMATIONAL REPORT?

by

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CHAPTER I

AUTOMATION: AN IDEA OR AN ERA?

Does it Seem like "only yesterday" since the end of World War II? In point of time, it has been a decade. But in technological progress, it has been a generation. Methods and equipment that were the last word in the early post-war years are already obsolete.[1]

Beginning in January of 1955, Fortune Magazine commenced a series of articles on the future of America to be presented in twelve consecutive issues. Mr. David Sarnoff, Chairman of the Board, Radio Corporation of America launched the series with a presentation on "The Fabulous Future." In this article he said:

> This era of automation is upon us. Electronic machines will not only compute, remember, and file information--tasks they have already taken on for business offices, banks, factories, and research laboratories--but they will perform more and more routine jobs now handled by people. Production especially will lean more heavily on electronics in the immediat years ahead. Automtic equipment will take much of the drudgery and spoilage our of manufacture. It will do the jobs of selecting, testing, checking, and handling raw materials and finished products. The goods thus produced will then be stored and inventoried electronically.[2]

This will call for a change in products in some instances and a change in methods of operation in most of todays business organization. One is inclined to immediately assume that the displacement of workers

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[1]"How to Profit From Technical Progress," Duns Review and Modern Industry, January, 1956, p. 37.

[2]"The Fabulous Future," Fortune, January, 1955, p. 114.

will result in a situation of unemployment , but Mr. Sarnoff feels that such is not the case. The history of American economy proves that changes mean progress and that eventually many new jobs will be created for every job cancelled out.[3]

In the same issue of Fortune, information concerning the views of Walter P. Reuther, who was then the President of the Congress of Industrial Organizations is as follows:

> In Reuther's mind the guaranteed-wage plan means more than insuring workers a full year's salary. Indicative of his thinking is the change in title of his plan from "guaranteed wage" to guaranteed employment." Reuther now sees automation - and the loss of jobs - as his chief problem. And the guaranteed employment plan, he feels, would be a way of regulating the introduction of automation in the auto industry. Under the plan, company contributions to compensation funds would have to rise when men are laid off; hence managements inclination to invest in labor-saving machinery during business turndowns might be tempered by the cost involved in additional unemployment benefits. Automation would be more likely to be introduced in times of expanding business, with less disruption of jobs.[4]

Walter Reuther was quoted by the Washington Star as saying "We welcome the potential benefits which automation can and should bring, but we oppose those who would introduce automation blindly and irresponsibly, with no concern for any result except the achievement of the largest quick profit for themselves."[5]

A vivid example of the impact of automation can be shown by a report in Fortune. Engineers in Bendix Aviation's Detroit laboratories developed a machine to solve a specific problem--the production of cams for fuel-metering systems in jet engines. The tool makes finished cams from blueprints in two days. Formerly such cams took two months to make.

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[3]Ibid. [4]Ibid., pp. 47-50.

[5]Washington Evening Star: Oct. 17, 1955, p. A-6.

Punched tape governs the operation of the "cam machine" which follows specifications to within 0.001 inch. The tape is punched by an IBM machine that transfers information from punched cards, which themselves carry blueprint specifications. The card punching requires skills that can be taught to a high school graduate in three weeks; the metal blank from which the cams will be made can be adjusted by any skilled machinist.[6]

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[6]Products & Processes, Fortune, January, 1956, p. 163.

CHAPTER II

AUTOMATION: WHAT IS IT?

But now let us pause for a short while in order to examine this seemingly monstrous word AUTOMATION. What is it? What does it mean? How did it come into its present position of influential magnitude?

To thousands of people who do not know its meaning, automation suggests a brand-new class of machines, different from any we have ever had before, and so superior to man himself that they may rise like Frankenstein's monster to destroy all. The word alone is enough to provide dramatic depictations of wholly automatic factories where ogreish machines with super-brains will grind out products completely void of human endeavor. Automation has become a kind of modern bogey man with which to frighten people.[7]

"Automation is a new word, actually a contraction of 'automatization,' denoting both automatic operation and the establishment of an automatic process and set-up. In the latter sense it includes such phases of industrial activity as product and process redesign, the theory of communication and control, the design of machinery and plant layout."[8]

It is indeed a rare occasion for a day to pass without some mention of automation in our daily newspapers or our weekly and monthly

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[7]"Tomorrows Technology: Master or Servant?" The Management Review, April, 1955, p. 210.

[8]John Diebold, Automation (New York: D. Van Nostrand Co., Inc., 1952), Condensed by Controllership Foundation, Inc., New York, 1954, p. 1.

magazines. One would think that with such notoriety a better understanding of the word would be in strong evidence. Yet, John Diebold tells us that exactly the opposite is happening:

> "Automation has been extravagantly heralded by some as the threshold to a new Utopia in which robots and 'giant brains' do all the work while human drones recline in pneumatic bliss. This is dangerous nonsense. At the other extreme, black pessimists have pictured automation as a Fifth Horseman of the Apocalypse, an agent of doom leaving mass unemployment and degradation of the human spirit in its wake. This, too, is as unrealistic as to think of airplanes only as 'things that may crash.'"[9]

Automation is the development of ingenious control mechanisms, such as the electric eye, mechanical brains, and other intricate electronic and radiation devices, which can disect and control the operations of machines. One way of defining automation is to say that it is a means of organizing or controlling production processes to achieve optimum use of all production resources--mechanical, material, and human.[10] The concern of automation is with the production process as a system, and a subsequent consideration of each element as part of the system. In planning for automation primary attention is directed toward the system, and the task of integrating the separate elements into the system. The whole problem of production is approached anew--even the product in reappraised in terms of its function and the functions of the machines that handle it.[11]

Walter S. Buckingham Jr., Associate Professor, Georgia Institute of Technology explains automation as a term embodied by four major

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[9]"What is Automation?" Colliers, Mar. 16, 1956, p. 38.

[10]U.S. Congress, Joint Committee on the Economic Report Subcommittee on Economic Stabilization, Hearings, Automation and Technological Change, 84th Cong., 1st Sess., 1955, p. 8.

[11]Ibid., p. 15.

principles--mechanization, feedback, continuous process and rationalization.[12] From these four principles he defines automation as any continuous and integrated operation of a rationalization production system which uses electronic or other equipment to regulate and coordinate the quality and quantity of production.[13] Mechanization is, of course, the use of machines to perform work. Feedback is a concept of control whereby the input of machines is regulated by the machines own output so that the output meets the conditions of a preset objective. Continuous process is the concept of business enterprise asan endless process and not one that can be started and stopped randomly; the regulation of a constant flow of goods has become a major concern of management. Rationalization is the analysis of the entire process from raw material to finished product so that every operation can be designed to contribute in the optimum of efficiency toward the desired end.

Mr. D. J. Davis, Vice President of Manufacturing, Ford Motor Co., views automation at Ford as "the automatic handling of parts between progressive production processes." It is the result of nothing more than better planning, improved tooling, and the application of more effecient manufacturing methods which take full advantage of the progress made by the machine-tool and equipment industries.[14]

Definitions pertaining to automation appear to be somewhat parallel to the "dime a dozen" classification. Everyone seems to have a slightly varied impression of just what the term encompasses. In fact, the Society for Advancement of Management published an automation dictionary consisting of ninety-six definitions ascribed to various terms generally associated

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[12] Ibid., p. 31. [13] Ibid., p. 32. [14] Ibid., pp. 53-54.

with the word. Automation is defined as "the modern-day engineer's word for the state of being automatic. Once referred to machine tool applications, but has come to mean the act or method of making a manufacturing, or processing, system partially or fully automatic."[15]

Walter P. Reuther, in testifying before the Congressional Hearing on Automation and Technological Change, presented his idea that automation was a technique by which whole batteries of machines, in some cases almost whole factories and offices, could be operated according to predetermined automatic controls. The raw material is automatically fed in, the machine automatically processes it, the product is automatically taken away, often to be fed automatically into still another machine that carries it automatically through a further process.[16]

The nature of automation can probably be characterized by three simple statements: First, the concept of automation is a welding together of production steps. It is viewing the process as closed and integrated systems. Secondly, it is incredibly complex, being easily within the half dozen most advanced technologies of our time. Basically it deals with the transmission and use of information for purposes of machine control and optimizing production. The third point is that it has widespread application. It can be applied to many types of businesses and industries.[17]

The term "automation" according to Time first described the automatic transfer of auto parts from one metalworking machine to the next. But its meaning has broadened as fast as its application. A

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[15]"Automation Dictionary," Advanced Management, July, 1955, p. 30.

[16]Hearings, op. cit., p. 98. [17]Hearings, op. cit., pp. 8-9.

few purists still claim that it should be applied only to completely automatic machines that feed back into themselves, reports of how they are doing, and correct themselves if necessary. But most businessmen lump under automation all automatic machines and processes including the giant tools that follow directions punched on a tape, huge computers that make thousands of intricate mathematical calculations in a fraction of a second, gauges that check fractions of a hair breadth with a tiny beam of light.[18]

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[18] Time, Mar. 19, 1956, p. 98.

CHAPTER III

AUTOMATION: FROM WHERE?

Automation is not a new idea. In 1784 an entirely automatic, continuous process flour mill was built. No human labor was required from the time the grain was received at the mill until it had been processed into finished flour. In 1801 an automatic loom controlled by punched paper cards similar to those used in modern office equipment, was exhibited. In 1833 the unglamorous process of bisquit making had been mechanized in the British Navy.[19] Nearly three centuries ago an inventor in Danzig built a loom that could weave six webs at once.[20] Automatic control is as old as the industrial revolution, for the decisive new feature of Watt's steam engine was its automatic valve control, including speed control by a "governor."[21] Self-regulating mechanisms were used by the early Dutch to keep their windmills facing into the wind, and by the Romans in float-control valves.[22]

For years the railroad industry and manufacturers of signaling devices have thought of railroad signaling as a system of control engineering; and this dates back to the inception or invention of the track circuit as early as 1872.[23] Mr. M. A. Hollengreen, Pres ident, National Machine Tool Builders' Association stated in the Joint Committee

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[19]Diebold, loc. cit. [20]Management Review, April, 1955, loc. cit.

[21]"Can We Survive Technology?" Fortune, June, 1955, p. 107.

[22]Hearings, loc. cit. [23]Ibid., p. 543.

Hearings on Automation and Technological Change "Actually, machine-tool e engineers do not talk about automation. They have actually been building automatic devices into machine tools for fifty years. They naturally take pride in their most recent accomplishments, but they expected them. They do not regard automation as something entirely new and unforeseen.[24]

Back in the days after the Civil War when lathes were first developed, the operator had to take the workpiece in and take it out by hand in order to make a single outside cut. Then a turret lathe was developed on which two or more cuts, both internal and external could be made without removing the workpiece from the machine. Next the industry devised means for moving the workpiece automatically from position to position in the machine. By 1920 it was possible to perform ten to fifteen operations on such machines without moving the work by hand.[25]

Oil refining has been on a continuous-flow or automatic basis for over thirty years. Automation manufacturing has been highly developed for some time in a number of other processing industries. The continuous-flow technique has become the standard method of production of certain chemicals, some kinds of food, paper, and for the refining of ores. The production of cigarettes is an almost wholly automatic process. The dial system of telephone calls is an example of automation that has been with us for quite a while. The New York Telephone Company began installation of dial telephones in 1922.[26]

Even in retailing automation has a long history. Vending machines for selling merchandise date back for quite a number of years. The future for automatic selling could be a tremendous development and a revolution in the selling phase of modern business. The Washington Post and Times

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[24]Ibid., p. 591. [25]Ibid. [26]Ibid., p. 400.

Herald reported that we may have some pleasant surprises in our future as a result of automatic vending. Robot coin-operated restaurants, cooking hot meals in a matter of seconds; automat groceries in apartment houses, dispensing foods preserved by atomic radiation; vending store-fronts which will serve if we arrive after the regular store hours.[27] All of these and many more have, of course, been associated to a promotional device called the push-button age, and most generally jokingly accepted as something to day-dream about - but the truth of the matter is that we are slowly but surely approaching a push-button existence - and I'm not so certain that it can still be categorized as "slowly." With industry and its associates vitally concerned with automation today and its highly promising future, how can the home and other "elbow-rubbing" aspects of everyday existence escape the tentacles of progress?

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[27] Washington Post & Times Herald, Oct. 19, 1951, p. 18.

CHAPTER IV

AUTOMATION: OFFICE UTOPIA?

Undoubtedly one of the most fertile fields available for the proponents of automation evidences itself in the mass of paper, reports, and accounting records that not only bogs down, but at times, seemingly inactivates many large enterprises. With the rapid increase of clerical office workers to a size unthought of a decade ago, office automation appears on the horizon as a chivalrous knight in shining armour (with a few cams, wheels, cogs, and transistors tossed in for modernization). The increase of clerical personnel over production personnel since the turn of the century has been in the ratio of two and one-half to one.[28]

Until recently the development of machines to lighten the white collar worker's load has been overshadowed by the development of devices to relieve man's back, instead of freeing his mind from the throes of monotonous drudgery.[29] The typewriter, adding machine, punched card equipment, and other office devices which are now as common as the zipper on todays clothing, are a few of these past developments.

We can confidently expect that advances in automation in the office field will make it possible to supply types of information which have long been needed but which could not be economically provided. Experiences here may be likened somewhat to that when punched card

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[28]F. A. Lamperti and J. B. Thurston, Internal Auditing for Management, (New York: Prentice-Hall, Inc., 1953), p. 3.

[29]Hearings, op. cit., p. 79.

equipment was introduced. The transistor, the magnetic core, and the vacuum tube will undoubtedly reduce the work of many large scale clerical positions.[30] There is every reason to believe that the development of cheap and versatile electronic data-processing machines will not be accompanied by a major reduction, if any, in the number of office jobs. The development and introduction of punched card tabulation and accounting methods has not displaced people. Instead, the lower costs and increased possibilities for timely information has made it possible to meet more of the demands for increased facts to guide decisions by American businessmen and governments. Percentage wise, the result of this along with other factors has been an increase in the proportion of the labor force in clerical occupations from about three percent in 1900 to twelve per cent in 1950.[31]

Office automation, making use of the high speed capabilities of electronic data-processing machines, will relieve considerably the massive paper-handling and processing problems of the Nation's businesses and offices.[32] In addition to this there will also be an increase in productivity and quality control.

It is highly apropos at this time to take a look at this tool of automation, the automatic data-processing system. It can process data for statistical tables, payroll computations, inventory reports, accounting data, information on insurance payments and many other of the like, too numerous to mention. Major characteristics of the data-processing system are:

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[30] Ibid. [31] Ibid. [32] Ibid., p. 583.

1. It is automatic and self-sequencing--this means that it can carry out long and varied sequences of operation without the need for human intervention.

2. It operates at high speed--two numbers ten digits long can be added together in a few ten-thousands of a second. It should soon be possible to build machines capable of adding or subtracting ten-digit numbers at a rate of 100,000 times a second. This high speed characteristic can be translated into great savings of time and cost.

3. It has a "machine language" consisting of patterns of electrical signals that can be used as code symbols for numbers and letters of the alphabet. Since it is able to communicate by means electrical signals, it is able to translate information from (a) the hole-no hole code patterns on punched cards or teletype tape, (b) from impulses originating in modified typewriter keyboards, and (c) from records made on magnetic tape or wire.

4. It is able to receive or transmit information automatically over any desired distance.

5. It is able to make certain elementary yes or no decisions and to follow different courses of action in accordance with these decisions. In processing records of checks that have been issued and cashed, it can be directed to compare the serial number of each check as it is processed against the serial numbers for checks against which a stop payment has been placed. When the check is located the machine will deviate from the routine action.

6. It provides for large-capacity data storage and for high speed selection and retrieval of information so stored.

All of the above characteristics give the data processing system unusual adaptability to a wide variety of conditions affecting the way data originates, how it is handled, communication of data from place to place, and processing to provide a variety of records and reports necessary to effective management.[33]

The system providing the versatility and adaptability as enumerated above consists of four principle parts which should be mentioned and briefly explained in order to acquire a semblance of or smattering of knowledge concerning the "what" and "how" aspect of the system.

The first two, input and output devices, are very closely related. They include equipment to read and punch paper tape or punched cards or to produce a printed page as well as magnetic tapes. The magnetic tape is normally a ribbon of metal or plastic with oxide layer that can be magnetized for the encoding of information. Most computer tapes are about one-half inch wide and can store 200 characters to the linear inch--this means that a seven inch diameter reel can store information equivalent to that which could be recorded on about 200,000 punched cards.[34] Reading or writing to and from these tapes proceeds at a rate of about 1,500 ten-character words each second.[35] These words can be read automatically from any distance over which it is practical to transmit electrical signals through wires, cables, radio or other communication media.[36] In this respect it is quite possible for the next decade to see breakthroughs in automatic processing and transmission of vital business data beyond the imagination of management today. One company

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[33]Ibid., passim, p. 588. [34]Ibid. [35]Ibid., p. 589.
[36]Ibid.

plans a data processing center in a part of the country where it has no manufacturing operation, to function as the hub of a vast network, assimilate information and then return it in analyzable form to the plants, central executive and district offices.[37] Another possibility seen for large companies is to set up sub-collection points at strategic locations all over the United States. Information from regional plants and sales offices would be transmitted to these subcenters, and automatically be converted to data language on a computer medium. Much diverse information such as inventory, production and payroll data would be consolidated and classified at the subcenter prior to transmittal to the main data processing center. Then at the main center, the data would be completely assimilated and in an incredibly short time, concise reports would be on executives desks.[38]

Internal storage on memory constitutes the third principle. Space is provided for about 1,000 to 4,000 ten-character units of information, including both the instructions to the machine system and the data to be worked on, at one time.[39]

The fourth principle, the arithmetic-logical unit, is built up of circuiting that accomplishes the deserved switching and counting functions necessary to select and read information to and from the input-output units and to carry out the operations of addition, subtraction, multiplication, division, comparison and the like.[40]

Although the present trend appears to be completely obsessed by the magic of automation, many firms are proceeding slowly, step by step,

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[37]"The Fitful Beginnings of Office Automation," The Management Review, Feb. 1956, p. 126.

[38]Ibid. [39]Hearings, op. cit., p. 589. [40]Ibid.

system by system. Rockwell Manufacturing Company has used order processing in a single division as one of their positive steps and found that it was possible to process an order in one day rather than the week previously required.[41] The Budd Company in Philadelphia has begun to integrate its systems, beginning with accounts receivable and billing.[42] Montgomery Ward and Company's system centers about computers use for financial control and sales analysis.[43] Commonwealth Edison Company of Chicago, Illinois is utilizing automation for their billing. They are installing an IBM 702 and expect to process 1,000,000 accounts with it.[44] The A. E. Staley Company of Decatur, Illinois is rapidly advancing into the data processing field with payroll, sales records, repair costs, inventory costing, and all control inventory reports. By January 1957 they expect to have all invoicing mechanized.[45]

An indication of the current impact on paper work the nation over can be mildly understood by the fact that "In business offices automation has rolled on steadily and so quietly that few people realize the manufacturers of business equipment has grown to a $2,000,000,000 industry.[46] Prices for the purchases of the automatic data-processing systems are about $1 million or more. Prices for the smaller type range from about $50,000 to $800,000.

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[41]Management Review, op. cit., p. 127. [42]Ibid. [43]Ibid., p. 128.

[44]Address by Mr. Grant H. Weir, Comptroller Commonwealth, Edison, before Navy Graduate Comptrollership Class, Mar. 9, 1956.

[45]Letter from Mr. William White, Assistant Controller, A. E. Staley Co., Decatur, Illinois, Mar. 15, 1956.

[46]"Automation: Liberator of Labor," The Management Review, July, 1955, p. 456.

[47]Hearings, op. cit.

The wire services appear to have an invaluable role in future office automation. Through advantageous useage of private wire facilities it will be possible to integrate functions and operations of every office, factory and branch of the business organization, regardless of geographic location. This would give complete, centralized and up-to-the-minute control of all information deemed essential to any profitable operation. The heart of such telegraphic communications appears to be perforated tape. It provides a "common language" that can be read by electronic computers and other modern machines. Once the information is placed on perforated tape, no further manual copying or retyping is necessary. The information is transmitted, edited, sorted, routed, duplicated, and stored--all automatically according to a predetermined plan.[48]

Management and employees are beginning to realize that office automation is a wonderful thing but does not constitute a cure-all. The human factor in business not only remains but the dependence upon human skills and abilities in the automated office will be greater in the future than in the past. There will undoubtedly be greater opportunities for office workers under an automated system for they will perform a greater portion of "brainwork," being relieved of drudgery and purely routine work, thus becoming an integrated part of management itself.[49]

It appears as though one of the major areas of confusion and lack of understanding in the big switch to automation in the offices of private industry emanates from the fact that the old school general accountant, whether he is a clerk or Vice President, is not trained to

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[48]Duns Review and Modern Industry, October, 1955, pp. 66-67.

[49]"Automation and the White Collar Worker: Fact vs. Fantasy," The Management Review, April, 1956, p. 286

understand the problems or limitations of the data-processing system. Management must re-think and re-train in this area to the utmost degree.

An accountant cannot afford to be a passive onlooker to the scene from the hit production "Automation." Developments in this field are of considerable importance to him from two rather important viewpoints. First, as an analyst and interpreter of financial data, he should be vitally interested in the quality of the tools used in producing the data he subjects to critical review and scrutiny. Secondly, as an auditor, he should be quite seriously concerned with the possible impact the use of these new tools might have upon controls with which he has been accustomed to have financial transactions surrounded.

Electronic data-processing equipment, if used properly and skillfully, should undoubtedly open up new and fertile fields for accountants. Business information will be handled with the epitome of speed without human intervention. Although electronic machines will change prevailing methods of processing and recording information to some extent, the same need for control, and probably the same patterns of control will continue to exist. The use of electronic equipment will facilitate management decision-making by faster processing of data and will render possible the use of advanced mathematical techniques in the operations of business. It is along these lines that the role of the accountant is most likely to change, with mathematics and statistics assuming greater importance in business procedures.[50]

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[50]"How Will Business Electronics Affect the Auditor's Work"? The Journal of Accountancy, July, 1954, p. 44.

CHAPTER V

AUTOMATION: LABORS DEBACLE?

When the term automation first gained a firm grip on the thinking of the nation's labor leaders and top management of industry, there were many controversial discussions and clamours concerning the future of the nations labor force. There were those who foresaw labors future as a drab black prospect associated with bread and soup lines, while others depicted a bright gay future of more pay, less working hours and more leisure time away from the noise and hub-dub of the factory.

However, there seems to be general harmony in the thought that automation is essential to the dynamic progress of the nations economy and the continuance of the days standard of living. John H. Rittenhouse writing for The Controllers Institute says "Automation is a potent force in our economy today."[51] Benjamin F. Fairless in a speech before the Greater Johnston, Pennsylvania Chamber of Commerce said "There is nothing new about automation except the word itself. It is only another little step in the slow and plodding progress of man toward a richer, fuller life and a better, freer world."[52] Mr. Fairless further pursued the thought in saying that the only way we can hope to achieve the fullest measure of employment and a higher standard of living is through the

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[51]"Profit Planning Under Automation," The Controller, January, 1956, p. 48.

[52]"Tomorrow's Technology: Master or Servant"? U.S. Management Review, April, 1955, p. 210.

widest use of new and better machines.[53] He brought his remarks to a close with the reminder that "the day that our economy stops growing and changing is the day that our nation will have started to die.[54]

Walter Reuther feels automation can bring a four-day work week, longer vacation periods, and opportunities for early retirement, as well as a vast increase in our material standards of living.[55] Robert C. Tait, President of Stromberg-Carlson Company feels that "We desperately need automation to maintain our standard of living with the onrush of our population increase."[56]

Control Engineering, in order to discover labors attitude toward automation, surveyed most of the nations important labor leaders. Following are a few of the most significant comments:

> Mine Workers - We decided it is better to have a half a million men working in the industry at good wages and a high standard of living than it is to have a million working in poverty and degradation . . . anything that man can do to take slavery out of the daily toil of the human being is a contribution toward improvement of the race.
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> Auto Workers - . . . want to force automobile manufacturers not to introduce new machinery in slack periods, when it would cause unemployment.
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> Machinists - . . . machinists make the machines and are anything but unhappy about the trend toward automatic machinery . . . unions will pick up maintenance jobs where they lose production workers.
>
> Packinghouse Workers - President Don Mahon fears that new labor-saving machinery wreak social havoc. He sees the possibility of all workers being reduced to the same pay level, which would destroy the incentive for personal improvement. When higher paying jobs no longer exist, the greatest single factor resulting in the independent and aggressive nature of the American worker will have been eliminated.

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[53]Ibid., p. 211. [54]Ibid., p. 212.

[55]Washington Evening Star, Oct. 17, 1955, p. A-6.

[56]Washington Post & Times Herald, Oct. 19, 1955, p. 17.

Office Workers - . . . is not concerned about so called labor-saving devices . . . attitude is that where two employees are let out for a machine, two others are needed to care for it.

Oil Workers - It is inherently good to get more work done with less labor. This good can be translated into terms of a greater abundance of goods for everyone, less drudgery for workers, shorter hours of work, and a generally higher and more comfortable standard of living.

Electrical Workers - Lets look at it sensibly. Why should we oppose cost reduction as a principle? We understand the facts of life in this mass-production society. But we think it is elementary that the social and economic development must go hand-in-hand with the technological development . . . our attitudes should be to welcome these developments but to insist that the benefits be distributed equally among the workers, the owners, and the public.[57]

In order to take a good common sense look at the effects of automation on labor, we must restrain our emotional traits and view the situation broadly. Expansion and more effecient methods of operating spell increased production. Increased production necessarily spells the blossoming of employment, from the supplies of raw material, the producer of the finished product, the transporter, and the distributor. The critics of automation in industry are much too prone to expand their thoughts and sights from the obvious narrow-gauge track upon which they are operating. The opponents of technological progress cry "mass unemployment" when they hear of a new process that has displaced a number of workers. This in a sense parallels the ostrich with his head buried in the sand. The economics of automation are not quite that simple. If these loud voices would take into account not only the increase in indirect labor, but also the increase in employment made possible by expanding and more efficient production, their voices might incline to drop a bit. Although the labor required per unit of output declines, more workers will be needed to supply the increased

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[57] "Union Leaders Look at Automation," Management Review, op. cit., pp. 221-222.

output demanded in an automated economy.

Automation has created new jobs even before its machines have wiped out old jobs. Most people are aware that technological progress always creates more jobs eventually than it destroys. The big worry is the time lag, or the period during which men have no work, between old jobs and the new. Such a delay was in existence during the first industrial revolution, however, this situation doesn't appear to have any basis for rearing its head in the present trend to automation. As a strong example in stressing their point, one new industry has already evidenced itself in America. There are now more than 1,000 companies engaged either wholly or partly in the manufacture of automation equipment. Their aggragate output in 1955 totaled more than $3,500,000,000 and the industry is one of the fastest growing in America.[58]

Today the active labor force is 41 per cent of the total population and, except for war years, it has been 41 per cent for the past thirty or forty years.[59] Now if we project this idea to 1975 we would get a labor force of 90 million or 41 per cent of 220 million population. However, taking into account economic patterns and age distribution the 1975 active labor force will be substantially reduced to about 86 million or up 22 million from the present 64 million. This figure could be as low as 78 million. Project our labor needs to 1975, 78 to 86 million workers will not be enough unless more automation than we can now foresee reduces the need for workers,[60]

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[58]Colliers, op. cit., p. 42.

[59]"What Automation Means to America," The Management Review, November, 1955, p. 775.

[60]Ibid.

Our standard of living has been increasing at the rate of 2.65 per cent since 1940 and we certainly expect a continuation of that rise as our minimum objective. By 1975 we will have a gross national product of $858 billion. By 1975 each worker will be producing $10,150 worth of goods and services per year so, we will need 84 million workers to produce $858 billion of goods and services.[61]

Time magazine had this word about our expanding standard of living and labor:

> . . . U. S. Businessmen busily installed new push button machines to produce everything from auto engine blocks to electronic printed circuits. To make carbon dioxide, Liquid Carbonic Corporation spent $1.5 million for a new completely automatic plant in Oakland, California, in which two highly skilled technicians produce as much as was formerly turned out by fifty men. At the start of 1955, such automated factories were a great worry to U. S. labor leaders, who feared wide-spread unemployment. But as they took a harder look at automation, the fears began to fade. If the U. S. standard of living keeps expanding, as everyone expects, the great problem will be a continuing labor shortage.[62]

Automatic devices have speeded up the consumption of new products and have benefited labor with a shorter work week and higher pay. In the canning industry the time to cook corn for canning has been reduced from thirty-seven to seventeen minutes due to technological advances and change.[63]

Power-driven machinery is perhaps one of the most obvious of all the factors that contribute to increased production capacity. Workers who have the assistance of such aids can produce more than workers who have only hand tools and human power. The operator of a huge power shovel

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[61]Ibid. (See remainder of article for more statistics on labor shortage in 1975.)

[62]Time, Jan. 9, 1956, p. 79.

[63]Lecture by Dr. Howard Stier, Director of Statistics, American Canners Assoc. before Navy Postgraduate Comptrollership class, Feb. 16, 1956.

can move more dirt than can a worker with a spade. Even counting the man hours that went into making the power shovel, the amount of dirt moved per man hour is greater.[64]

The Ford Motor Company believes that instead of adversely affecting employment, automation has created better jobs, while at the same time making them safer and easier. They do not share the apprehension that increased use of automation equipment may throw thousands of people out of work or otherwise displace the economy. Without automation in the steel, chemical, refining, food processing and cigarette industries there simply would not be enough of their products to fill our needs, and certainly not at prices we could afford to pay. The growth of automation should cause no more than a gradual shift of employment, a shift comparable to that from backward industries into new and growing industries. The most significant feature of any shift is that much of it will be from menial labor to higher skilled, better paid, safer and more interesting jobs.[65]

To bring this discussion on labor and automation to a close, I shall again use Mr. Walter Reuther and the Ford Motor Company as subject matter. Mr. Reuther and a Ford Vice President were touring Ford's automated engine plant in Cleveland. As they walked past huge self-operating tools that bored cylinder holes, positioned connecting rods and bolted down manifolds, the Ford Vice President joked: "You know, not one of these machines pays dues to the U.A.W." Reuther replied: "And not one of them buys new Ford cars, either."

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[64]Philip Hernette, The Future of American Prosperity, (New York: The MacMillan Co., 1955,)p. 27.

[65]Hearings, op. cit., p. 58.

CHAPTER VI

AUTOMATION: MANAGEMENT'S HEADACHE?

A short while after mechanized artillery was introduced into the British ground forces, a group of visiting Army persons were observing and studying the new techniques. While watching several of the units firing in accordance with the new mechanized equipment system, the group noticed that each unit had one soldier standing alone several yards to the rear of the artillery. This lad seemingly appeared to be firmly holding something with both hands. When the group questioned their escort concerning the role of the soldier in relation to the rest of the unit, they received the following answer "Oh yes, well you see, under the old system he always held the reins of the horses while the guns were fired and now that we are mechanized we haven't been able to find another position for him."[66]

Although this story may seem somewhat ridiculous it nevertheless points out one of the many top management problem areas brought about by the onslaught of automation in business, both in clerical and production. It is rather obvious that management must plan and re-plan, think and re-think, and quite carefully consider every possible problem and complicating feature possible prior to making the big leap into automation as it is presently known. Management's decision today no longer concerns whether or not to automize, for automation has become basic to meet competition in every field. The successful management and competitors are those who plan

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[66]Prof. Carl Clewlon, lecture before Navy Graduate Comptrollership Class, Geo. Washington Univ., Feb. 16, 1956.

their automation.

Top management interest and support is needed even in the mutual research phases of planning and installing an integrated data-processing system, according to a recent Controllership Foundation report, which analyses the experience of the Port of New York Authority in conducting such a system analysis. The program was instituted to review the accoounting and control requirements involved and to establish procedures to assure the most effective use of the new equipment in the system installed. Although the research pertains only to the data-processing system, it is indicative of the planning and thinking required by management. Some basic lessons derived from this particular research program are:

1. Research and planning must have the support of top management, and one or more key executives must acquire a knowledge of basic facts about electronic data-processing.

2. The object and scope of the research program must be clearly defined.

3. Responsibility for the program should be firmly established, and adequate authority, staff and resources assigned.

4. The personnel for basic research and planning should be carefully selected.

5. The program should not move too fast in any specific direction initially.

6. The first objective should be to re-phrase the company's accounting needs in terms of processes and data requirements.

7. Requirements should be flexible to give the company a wider range of choice based on the gains expected from the new system.

3. In the pre-installation phase, the experiences of other companies can provide many valid short cuts.[67]

Automation shows promise of becoming an extremely powerful instrument or tool in the future. Proper useage will determine whether some manufacturers remain competitive or cease to exist. In this respect, we can say that the degree of automation in a manufacturing process will be determined by the maximum profits to be realized over a period of time.[68]

Planning for automation, regardless of the size of the industry, or the size of the function to be automized, or whether it be now, next week, or next year, is without a doubt the first and most important step in the change-over. Haphazard planning may lead to conditions of excessive inventories, high manufacturing costs, or inadequate capacities. Comprehensive planning by integrating marketing, engineering, and finance programs with manufacturing is the keynote of maximum benefits from automation. To dwell further on the matter, the extent to which any enterprise adapts the automation approach to manufacturing depends upon the maximum profits to be expected for a determined period of time. It is a result of determining the total revenue and selecting the combination of manufacturing methods that produce the desired volume of goods at the lowest total price.[69] One has only to look at the tremendous profits realized by the leaders of the automotive industry in the last two years to understand the profit potential afforded by present day automation to Detroit.

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[67]The Management Review, April, 1956, p. 286.

[68]The Controller, op. cit., p. 22.

[69]Ibid.

Dr. Vannevar Bush, President, Carnegie Institution of Washington in his testimony before the Congressional Hearings on Automation and Technological Change stressed several points applicable to management thinking and planning on the problem of whether to or not to turn to automation. To lower costs of production would naturally be a strong objective. Another is the increase in reliability of the product, process or system. Machinery always does as it is told to do whereas a human operator often makes mistakes. We also find that after the installation of automation a given industrial production operation experiences a decrease in flexibility, and thus, increases the costs of a change-over. In this respect, it would seem, then, that as the larger companies increase their own rigidity, they open opportunities for smaller companies to operate by reason of their flexibility. Dr. Bush feels this is a very important point "for I have long felt that our primary reliance against undue concentration of industry in this country lies in the continued advent of a new small, aggressive industrial units." Automation may lead to increased size and relative proportion of production of large units, it also has important effects in the other direction.[70]

The Lester B. Knight and Associates, a management consultant firm, in a statement submitted to the Subcommittee Hearings, outlined the basic economic conditions which compel the rise of automation. They listed three conditions: first, the growth in purchasing power, which has, of course, increased the size of the market; second, the development of operating problems emanating from the increased volume; and third, the forced reexamination of old products and processes in order to survive

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[70] Hearings, op. cit., pp. 614-615.

as a result of the development of new products and processes. They further observed that management becomes interested in automation and it becomes feasible only when one or more of three conditions exist. One, when the current capacity for a product or service is exceeded by present and forecast demand; two, the overtaxing of present methods of accomplishing work; and three, when sales volume is notably affected by competition.[71] Under these conditions management must take action leading to continued business success, or face the possibility of a crumbling retardation.

Competition, as we have seen, forces automation from the management standpoint. A business manager must use every resource at his disposal to keep up the volume of goods sold by his establishment. For every item he produces from the market, he has competitors a plenty, so his most serious and difficult problem is how to keep the customer coming in the door. He must offer the product at an attractive price, with the best quality he can apply at this price--and hope that he can keep selling more. He must keep his prices as low as possible by introducing whatever methods or practices he can. Business survival makes it necessary to reduce costs by increasing production effeciency. This is where automation steps on the stage. Increased productivity at lower costs will enable the manager to meet old and new progressive competition in an adequate manner.

A simple view again comes from the Hearings. If marketing shows that by reducing prices the volume of products sold can be raised, and the fellow with fewer dollars to spend can be reached, then the management begins working on costs. In the search for cost reduction methods, they turn to automation.[72]

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[71] Ibid., p. 637. [72] Ibid., p. 372.

Mr. J. J. Nance, President of Studebaker Packard Corporation feels that automation does not present a major problem for the small producer in the automotive industry since, in his opinion, a relatively small volume producer in an industry as large as the automobile can use automation effectively. The problem of the smaller producer is to secure and maintain the sales volume needed to permit enjoyment of the advantages of automation and to create the earnings necessary to make the capital investments required for the purchase of automatic facilities.[73]

To further amplify the point that increased competition and the desire to keep costs down have led to automation and increased productivity to would be possible to cite many examples of various industrial activities. However, we certainly should not lose sight of the fact that there must be a market for the product. So much money is invested in the automation tool that the plant manager must keep it at work for automation is most profitable at full production. The Standard Pressed Steel Company of Jenkintown, Pennsylvania installed a $140,000 automated furnace in its bolt factory. The furnace could be operated by one man instead of five. It boasted production 133 per cent, but unless it kept running continually it was not profitable.[74]

We have seen what factors tend to compel automation and the conditions which should exist prior to the final investments. Now it is time to determine whether or not management should make the tremendous investment necessary for automation. The Management Review lists six factors that should be considered and investigated before any attempt is made to set up an automation program.

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[73] Ibid., p. 417. [74] Time, Mar. 19, 1956, p. 98.

"1. Analyse plant and building . . . the building should in any case be suitable for straight-line production and should permit to volume production that is anticipated in the next decade and beyond. . . .

2. Analyse production . . . every effort should be made to keep production more stable and uniform throughout the year. . . .

3. Analyse the labor force. It is important to consider the qualifications and capabilities of the working force, how the workers can be adapted to or trained for automation, and perhaps most important--the attitude of workers and unions toward automation. It is management's responsibility to condition employees for automation and to explain its advantages, where workers will fit into the program, and how they will benefit from that program. . . .

4. Analyse production and labor costs.

5. Analyse Capital. The trend of the company's financial health should be plotted over the past years with particular reference to manufacturing costs, earnings, and the trend of reserve funds, which can be a major source of capital for an automation development program. . . .

6. Analyse your future. No company can or should embark upon any automation program without carefully considering whether demand for the present product is likely to increase, whether new or substitute products may be expected to provide new competition, or whether the product may just naturally become obsolete."[75]

For management, then, it can be said that automation poses the problem of adapting to new concepts and new methods of production--concepts and methods that require a complete "rethinking" of the purpose, as well as the organization, of entire production processes.[76] Industrial automation brings new problems as well as new solutions. In many cases redesign of products, processing methods, and machines must be accomplished in order to harvest all the fruits of automation. In order to do this we must "rethink" them all.[77]

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[75]"Six Key Steps in Automation Planning," The Management Review, August, 1955, p. 574.

[76]Colliers, op. cit., p. 38.

[77]Hearings, op cit., p. 17.

Mr. Melvin L. Hurni who is Senior Consultant, Operations Research and Synthesis Consulting Service of General Electric lists four potential advantages of automation for management which provides a well-balanced conclusion for this chapter. They are:

> "1. Increased productivity, an important tool in a competitive market and an important factor for the future of the wide predictions of shortages of labor continue to become more of a reality.
>
> 2. Uniform quality.
>
> 3. Better control of the flow of production, as a result of rigid mechanical sequencing to which human judgment or whim may only be applied at the input end or to the whole system.
>
> 4. Reduced running costs, which come as a consequence of the other factors above."[78]

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[78]"Decision Making in the Age of Automation," Harvard Business Review, Sept.-Oct., 1955, p. 52.

CHAPTER VII

AUTOMATION: AN AID TO GOVERNMENT'S BIGNESS?

Automation is progressing quite rapidly in government as well as in private industry. The same problem pertaining to manpower, planning, rethinking, and capital investment apply to the governmental side of the picture concurrently with the industrial side. Capital investment, perhaps, is not quite as obvious to some as it is to the government career people. The taxpayers and the Legislative and Executive Branch of the government serve as the counter part of the stockholders and Board of Directors on matters pertaining to fiscal expenditures and financial management. Any advent into automation for governmental agencies must first be thoroughly planned, completely justified and then wholeheartedly approved by the agencies top management (Secretaries office), the Executive Branch (Bureau of the Budget), and the Legislative Branch (Congress). This chapter will concern itself only with examples of automation in government with no further amplifications on problems and methods.

The Census Bureau is now using two mechanical brains, Univacs, for various studies. In late 1955 the machines were given the job of figuring out what business looked like in 1954. The job was done in three weeks. This would formerly have taken 200 to 300 employees using adding machines and other mechanical computers.[79]

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[79] Washington Post & Times Herald, Oct. 19, 1955, p. A-20.

An automatic hurricane weather station that can be parachuted into the eye of a hurricane to radio back data on wind speed and direction, barometric pressure, and air and water temperature is being developed jointly by the Bureau of Standards and the Navy. It is expected that it will be given a full scale tryout during the 1956 hurricane season. It has a range of 500 miles and can be used to monitor hurricane breeding grounds as well as to report weather from inaccessible water areas. Coded reports are sent every two hours and can be picked up by any shore or ship receivers within its range.[80]

SAGE which is "semiautomatic ground environment" has introduced automation into our countries defense against sudden aerial attack. Sage is an electronic brain capable not only of supplying instantly accurate details as to the strength, nature, direction, speed and altitude of an approaching enemy air fleet, but of organizing and directing our counter attack. By pushing a button, the human director can put in motion a concentrated interception strike, with the automation device actually steering the piloted planes and unpiloted missiles to the correct point. Pilots just go along for the ride, of course, they can launch their air-to-air missiles against enemy aircraft if they choose, otherwise Sage will do the firing for them.[81]

A rocket-firing electromechanical brain has been developed for the Navy Bureau of Ordnance to direct the distruction of ground-troop concentrations ashore from a shipboard installation.[82]

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[80] Ibid., Jan. 27, 1956, p. 56.

[81] Washington Evening Star, Jan. 23, 1956, p. A-8.

[82] Navy Times, Feb. 4, 1956, p. 40.

The Army unveiled the "Missile Master" in March of 1956, explaining that it was a completely electronic control system with a "robot brain" that will control the direction of the NIKE defenses of the Washington-Baltimore area. The manually-operated centers will be closed and a complex mass of radar screens, IBM machines, stock-market-like electric "tote" boards and mysterious mechanical memory boxes will take charge. The Missile Master is an electronic brain that detects enemy aircraft and missiles, and controls and coordinates the fire of Army NIKE missile batteries against such enemies.[83] The Treasury Department and the General Accounting Office are installing s ix electronic machines to process government checks. The high speed machines will keep track of 350 million checks per year by processing and reconciling them after they are paid. Under this system when a check is issued, essential facts will be fed into the machine, then when the check is sent to the Treasury for payment it will go through the machine and will either be verified or thrown out as incorrect. They can handle 1,500,000 checks a day.[84]

Top Government agencies are readying a study of SAGE as a possible solution to the Nations crowded air lanes. Sage, applied to civil air traffic, could possibly remove the inevitable lag in aircraft communications between control tower and plane, would be able to space aircraft avoid mid-air collisions and eliminate the danger and congestion of bad weather flying. It is believed that Sage could be used by civil aviation

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[83] Washington Post & Times Herald, Mar. 24, 1956, p. 22.

[84] Ibid., Oct. 15, 1955, p. 16.

to help sort out and properly distribute the complex and teeming aircraft picture on civil air lanes.[85]

The Navy Department has converted 85 per cent of all the computations involved in processing the departmental civilian employee payroll to a medium size Electronic Data-Processing Machine. The system enabled employees to be paid two days earlier at no additional cost. A study is currently being conducted with the view toward converting all time and leave record-keeping into an integrated data-processing system. This would eliminate manual posting to leave record-cards and provide current and accurate information for leave administration and planning purposes. Many other such utilizations are planned in the future. The Naval Ship Yards at Puget Sound and Portsmouth are also installing medium size machines. At Puget Sound it will be used for payrolls, force distribution reports, labor and material cost distribution, production control and scheduling and scientific computations. At Portsmouth it will be used for payroll and other fiscal accounting work.[86]

Captain J. B. Rawlings, Comptroller, Puget Sound Naval Shipyard speaking on the installing of the machine at Puget said

> ". . . I should like to state that is is not our contention that the IBM 650 is the only electronic data processing machine that will satisfactorily handle the accounting problems of a Naval Shipyard, nor do we claim that it is a final answer to the total job of data processing in a Shipyard. We so stated in our original justification of this equipment to the Bureau of Ships. We do feel, however, that our original selection of this equipment was the only proper one at the time and that our successful completion of every test to date has proven the feasibility of using this equipment. We expect to save enough from the pay-roll timekeeping and bond accounting applications to pay for the monthly rental of the machine. Savings from further applications will be clear profit."[87]

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[85] Washington Sunday Star, Feb. 5, 1956, A-1.

[86] Navy Comptroller Review, April, 1956, p. 3.

[87] Address by Captain J. B. Rawlings presented at the Bureau of Ships Comptrollership Seminar, San Francisco, California, Mar. 1[illegible], 1956.

CHAPTER VIII

AUTOMATION: CAN IT BE CONCLUDED?

Since 1940, 2,328,324 farmers have vanished from the scene. Where did they go? In 1940 there were 8,883,324 farmers. Today only 6,505,000. Farm help of a different sort has taken their place. Tractors that save two billion man-hours a year; mechanical pickers that do the work of forty men; grain combines that cut labor 85 per cent make up part of the millions of machines that help todays fewer farmers produce 40 per cent more crops and feed 30 million more Americans. Today's farmer is the most mechanized farmer in the world.[88]

In the last ten years farm productivity has increased between forty and fifty per cent, or roughly, more than twice as rapidly as productivity in the factory. We have heard of automation in the factory, but where it has really changed the employment situation is "down on the farm."[89]

Since 1940 the number of tractors on U. S. farms has tripled to four and one-half million; combines have increased 400 per cent to 950,000; corn pickers up 500 per cent to 640,000; harvesters 100 per cent to 170,000; hay balers 100 per cent to 393,000; and milking machines from

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[88]The Saturday Evening Post, Mar. 24, 1956, p. 103.

[89]"Wanted: Ten New Jobs Every Minute," Duns Review & Modern Industry, February, 1956, p. 42.

212,000 to 800,000. Farmers had invested $3.2 billion in machines in 1940 whereas in mid 1955 the investment reached $18.7 billion with millions being added each month. Twenty years ago a U. S. farmer raised enough to feed himself and ten others, now, with the aid of farm automation he is able to feed seventeen others, in spite of the fact that over two million have left the farm scene.[90]

The only reason for describing the farm situation in this concluding chapter on Automation is to vividly stress the point that automation is and will bring about changes in our day to day living, in the way we do things, and in the economy as a whole. Automation will bring about tremendous changes in our business and manufacturing practices, just as the development of mechanical devices to assist the farmer brought about, and is still bringing about, enormous changes in many phases of agriculture. The increase in the efficiency of the farmers means we can now employ more people in the production phase of industry. In the early 1800's about 75 per cent of our working population were employed on farms. We now have only about 10 per cent of the working population on farms--its not too difficult to vision the predicament we would find ourselves in had it not been for automation on the farm.

We are somewhat near the limit of both productivity and precision obtainable with manually operated machines. In order to provide the necessary increase in output (for a population of 220 million by 1975) and the closer tolerances which articles of the future will demand, it seems imperative that the breakthrough to automation occurs as expeditiously as

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[90]Time, Aug. 4, 1955, p. 63.

possible. The faster we can do so, the more rapidly we will reach our objectives. As automation continues, we can expect to witness additional evidence of a process which is characteristic of all highly productive economies, a great increase in the demand for services and in the amount of people engaged in the service industries. As an economy becomes more productive, there is always a movement of people from the arduous tasks toward the processing, distribution, and service industries,[91]

Automation is more than just machines, however complex. It is more than electronics. Successful automation calls for a balanced organization of methods, machines, and manpower designed to fit the pattern and needs of business. Labor, management, and government must work together to make certain that automation will be a stabilizing and not a disturbing element in our national economy.

Dr. A. V. Astin, Director, National Bureau of Standards, sums up the whole picture of automation fairly well with these words.

> "Automation is not new. It is the natural outgrowth of scientific research and development in the field of mechanization. It is new only in the sense that recent advances in the field of electronics and communication can now be applied to mechanization. And just as previous advances in mechanization have helped to further our civilization and to increase our productive capacity, so automation offers promises of even greater benefits.
>
> Automation makes use of high speed capabilities of electronic data-processing devices and computers. These new devices promise to serve society in several ways. They will be effective tools for increasing productivity and for production control. They will relieve considerably the massive paper-handling and processing problems of the Nation's businesses and offices. They will be high-speed servants for the efficient management of complex organizations, such as Governmental agencies. They offer to science and engineering a magnificent tool for undertaking scientific problems which were hitherto impossible because of the length of time required for solution. . . . As we grow, we become more and more complex. Continued research helps us to cope with this complexity."[92]

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[91] Hearings, op. cit., p. 404. [92] Ibid., p. 582.

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